

2-celled, ovules 2 in each cell, attached to the apex of an erect basilar placenta. *Style* compressed, slender, long-exserted, thickened and hairy about the middle, stigmatic-lobes 2, short. *Fruit* dry, indehiscent, obovate, .1 in. long, densely hairy, crowned by 3 accrescent, persistent, veined, oblong somewhat oblanceolate blunt calyx-lobes about .6 in. long; *seeds* (by abortion) solitary, ellipsoid, embryo straight in the axis of much fleshy albumen; cotyledons broad, flat.—DISTRIB. A single Malayan species.

JACKIA ORNATA, Wall. in Roxb. Fl. Ind., ed. Carey & Wall. II. 321. Young branches as thick as the little finger. *Leaves* oblanceolate, the apex sub-acute, narrowed from above the middle to the short stout petiole; upper surface glabrous and shining, the lower adpressed-puberulous; main-nerves about 12 pairs, prominent beneath; length 6 to 12 in.; breadth 2.5 to 5 in.; petiole .4 to .9 in.; stipules widely and deeply cupular, often 1 inch or more in length (to the end of the hairy bristles). *Flowers* .4 in. long; corolla many times longer than the calyx-tube, twice as long as the calyx-lobes when young, densely sericeous externally; bracteoles broadly oblong-ovate, shorter than the flowers, imbricate, sericeous, the lower ones sometimes connate. Wall. Pl. As. Rar. t. 293; Wall. Cat. 6284; DC. Prod. IV. 621; Hook. fil Fl. Br. Ind. III. 126; Miq. Fl. Ind. Bat. II. 237.

In all the provinces.—DISTRIB. Malay Archipelago.

A first note on the Life-History of Chermes abietis-piceæ Steb. MS.—By
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In a paper read before the Members of this Society in April last I gave an account of the mode of development of the alar appendages of the Spruce form of *Chermes abietis piceæ*, Steb. MS.* I propose to describe here in detail the further observations I have been able to make up to the present on the life-history of this exceedingly interesting insect. In order to make the somewhat complicated stages of life passed through understood, and the subsequent parts of this paper intelligible, it will be first necessary to give some short description of the various forms this insect assumes in its different generations.

* Vide No. 2, p. 57 of this Volume.

C. abietis-piceæ closely resembles its European confrère *C. abietis-laricis* in the fact that the individuals of one generation may assume different habits at different stages of their existence, and so set up the phenomenon known as parallel series. Further different stages in the life-history may be passed on plants of a different species, the host plants in India being the Spruce and Silver fir instead of the Spruce and Larch as in Europe. Blochmann, Dréfus, and Cholokovsky have made a series of the most important and interesting observations into these habits in the case of the European species within the last two decades or so, but the fact that a closely allied species lives in a somewhat similar manner on conifers in the N.-W. Himalayas seems to have remained unknown until discovered by the writer in 1901.

Before proceeding to describe in detail the stages as yet observed in this complex life-history, I may briefly run over the points which give rise to the phenomenon known as 'parallel series.'

In the early spring wingless ♀ of the *Chermes* are to be found upon the Spruce trees, they probably having hibernated upon them through the winter. These ♀ lay eggs from which shortly hatch out young larvæ which feed at the base of the young developing needles, causing them to swell up and coalesce into a pseudo-gall within which the aphids become enclosed. When fully grown about July the galls open, the larvæ crawl out, moult, and become fully developed winged insects. Some of them remain on the Spruce and lay eggs on it. A portion however of this winged gall generation leaves the Spruce and flies to the silver fir and lays eggs on it on the bark of the twigs or stem. The parthenogenetic ♀ which arise from these eggs either hibernate upon the trees and lay their eggs in the early spring of the ensuing year, or lay the eggs in the autumn. These eggs are covered with a white cottony substance which can be seen in the form of white specks all over the branches, and often all over the whole of the stems of young saplings. Each little white cottony mass contains a large number of eggs. From these eggs hatch out in the spring small larvæ which crawl up on to the newly-developed young silver fir needles and feed by sucking out the sap from them. It would appear that whilst some of this generation go on to the winged form, others remain on the needles and mature and lay eggs on them without ever acquiring wings or leaving the tree. A part of this generation, however, always acquires wings about the beginning of July, and these winged insects then fly to the Spruce tree and lay their eggs on the bark of the stem (in young trees) or branches.

My observations in the case of the Indian species seem to prove that either form in the two series can remain for a prolonged period on the one host tree before producing the winged generation which enables it to

return to the alternative host plant. This is evidently the case with the silver fir series, since eggs have been found on needles which only opened from the bud in May, and therefore could not have been those of the autumn or winter stem mothers of the previous season. These eggs hatched out, and quite young larvæ were found on the fully-developed silver fir needles six weeks after the spring larvæ had first appeared. There also appear to be other forms of the *Chermes*, and their feeding causes the silver fir needles of the year to become distorted and to curl and twist up, the individual needles being stuck together by the copious sticky excretions of the *Aphidæ*. This is especially noticeable on young plants, at times 70 % to 80 % of the terminal portions of the branches being treated in this way.

I will now proceed to consider these life-cycles separately, first dealing with the stages on the Spruce, and subsequently with those upon the silver fir.

THE CHERMES ON THE SPRUCE.

At the beginning of May, 1901, an examination of the Spruce at elevations of between 8,000 and 9,500 ft. in Jaunsar Barwar, in the N.-W. Himalayas showed small pinkish-white cone-shaped masses appearing here and there on the side branches. At the base of these in the axil between the branch and the cone (which was an unopened bud) masses of elliptical reddish eggs were to be observed, the mass being partially covered by the dried skin of the stem mother who died as soon as she had laid them. I have not as yet definitely ascertained whether these eggs were laid in the previous autumn or in the April of the year in which they were found. If at the latter period the stem mother evidently lays very early in the season, as snow was still lying in shady spots that year at the beginning of May at elevations of 9,000 ft. In the first week of the month a careful inspection showed young larvæ emerging from these eggs, and on cutting a section vertically through the small cone, young larvæ were visible in numbers between the bases of the young needles. Under the microscope these larvæ were seen to be minute red aphids furnished with a pair of antennæ consisting of two large basal joints followed by a narrower longer one which is surmounted by a hair. The beak was long and coiled, and three pairs of short legs were present. These minute larvæ were engaged in feeding upon the juices of the young undeveloped needles of which the pink gall consisted. Other patches of eggs examined were seen to be in a less advanced state, the bud above them having only just commenced to increase in size. The irritation set up by the young larvæ feeding at the bases of the needles soon causes the bud to swell, but instead of opening out into a short stiff brush of needles it develops into a gall or pseudo-

cone shaped green mass. When quite young there is no partitioning off into distinct cells to be observed within the cone, but as the swelling under this constant irritation continues, the interior gradually becomes divided off into distinct compartments, in each of which numbers of the young larvæ are to be found engaged in sucking up the juices of the walls of the compartment. In the third week of May this partitioning is already distinct, and a section of the small gall, which is by then bright green externally, and pyramidal in shape, will show a number of chambers situated on either side of a central axis. The young aphids are still bright crimson in colour, with legs and antennæ light yellow. No indications of wings are apparent at this period. As the gall becomes partitioned off inside the outside presents distinct diamond-shaped surfaces, each of which is the cover to a chamber below. A centre spot in each of these surfaces is lighter-coloured than the rest, and may form a minute projection. This would appear to represent the tip of the swollen up needle. It is never more than a minute projection, and in this differs from the European Spruce *Chermes* gall in which the spine or leaf top projects to some distance beyond the cone surface and can be seen to be the true upper portion of the needle. The false cone continues to steadily increase in size throughout June, and the young larvæ turns to a dark purple colour. They moult several times whilst in the chamber, and the white papery cast skins can be found in the cavities. From 6 to 8, or at times an even greater number of larvæ inhabit each chamber.

Several cones may often be found upon the same branch, and the writer has seen young trees absolutely loaded with these pseudo-galls. I have already described to the members of this Society* the manner in which the larvæ leave the false cone and develop their wings. A certain number of them on acquiring these fly off to the Silver Fir where they may be found in the first half of July clinging to the new year's needles.

The subsequent history of these winged forms from the Spruce has not as yet been traced.

THE CHERMES ON THE SILVER FIR.

The presence of the spring eggs on the silver fir is easily discernible, since they are invariably covered or partially covered with a white cottony material. At times this substance is so abundant as to clothe the bark of young trees more or less thickly from top to bottom, either entirely encircling the stem or occupying one or two sides only. At other times it is to be found only upon the upper portion of the stem of

* Vide No. 2, p. 57 of this Volume.

old trees and saplings or on portions of some of the side branches. Tops, leading shoots and branches, covered in this way with what look to be white fungous filaments, are often seen to be dying or dead and dried up. Round Deoban (elev. 9,300 ft.) in the Jaunsar Barwar Forests a number of both young and old trees have these dead tops. I have, however, up to date been quite unable to discover any cause for this dying off of the tops. It does not take place in patches but here and there in the forest. It will, of course, require very careful investigations carried out over a series of years before we are in a position to say whether the *Chermes* is in any way accountable for this state of affairs.

On examining the cottony patches with a lens, one sees that this white wool-like material forms a covering to a blackish skin. This skin is that of the dried-up stem mother *Chermes*. At her anal end a portion of a bunch of yellowish brown elliptical glossy eggs is visible, the rest of them being hidden beneath the dried-up skin. The eggs are superficially very similar to those to be found upon the Spruce at this period (the beginning of May). These eggs were present in millions on infested silver firs at the beginning of May 1901. Little larvæ were observed hatching out from the eggs about the first week in the month, and these at once crawl up on to the young newly-developed or developing silver fir needles, at that period just bursting through the bud scales, where they appear as minute black specks covering the young bright green tassels of needles. Seen beneath the microscope the young larvæ are apparently identical with those to be found at the same time on the Spruce.

Young Larva.—Red to crimson in colour, with two large basal antennal joints followed by a longer narrower one, this latter being surmounted by a bristle. Three pairs of short legs with two jointed tarsi, nine abdominal segments and a long curved proboscis.

Within a few days the young larvæ develop a white cottony covering. To the naked eye the young grubs appear to be surrounded by a white fungus. The microscope shows this however to be a white wooly substance which grows or is excreted all over the dorsal surface of the body. Towards the end of the third week in May these small aphids appear to become fullgrown, and they then lay the grape-bunch like masses of eggs of a new generation. They then die, the dead body skin remaining as a cover or partial cover to the eggs as in the case of the winter stem mother.

Since the whole of this first series of larvæ spend their lives upon the newly developed needles of the year, it becomes evident that this first generation of the year, or a portion of it, is a short-lived one; only stem females arising from the eggs, a winged generation being entirely

absent. The eggs so laid hatch within a week of being laid, and the young larvæ spread out over the undersurfaces of the still young green needles and remain feeding on them. At times these undersurfaces are quite black with the numbers of dark crimson-coloured larvæ attached to them. The production of these apterous forms continues until the first week in July, *i.e.*, up to the period when the monsoon rains burst over the Himalayas.

Towards the end of May, however, or beginning of June, the apterous crimson larvæ collect at the base of the needles and on the needle-bearing shoots. The irritation set up by their sucking operations causes the needles to draw together into a kind of corkscrew-shaped bud, the needles being twisted round one another and stuck together by the sugary excretion from the aphids. This excretion is also added to by an exudation of turpentine from the plant and round nodules of resin are to be found in the axils of the needles. A new and larger form of larvæ now begins to appear, yellowish in colour. These yellow aphids are to be found in the axil at the base of each needle, each having its proboscis firmly fixed in the tissue of the stem or leaf base. In addition to these yellow apterous forms a winged generation began to appear on the trees at the beginning of June. The winged insects found at this stage were on the twisted-up silver fir needles.

Apterous yellow larva.—Bright canary yellow with two curled, white, cottony, whip-like tails at the posterior extremity of its body. Patches of the white cottony material are also present elsewhere on body. The proboscis is short; antennæ six-jointed.

Winged form.—Dark orange-yellow in colour. Four wings large and black.

The crimson-coloured larvæ in the cotton developed stage of their existence are also numerous within the corkscrew-twisted needles.

The action of the insects at this stage is to contort and dwarf all the new shoots attacked. Some young trees were found with 90% of the new leaves treated in this way, whilst the branches below and the stem shewed numerous patches of eggs covered by the white cottony substance.

A few days later I was able to note that the yellow larvæ are also to be found in the open on needles which are not twisted-up in the corkscrew manner. Later on I found a winged form of the apterous yellow larva.

Winged form of apterous yellow larva.—Yellow green, with light silvery wings, one and three-quarters to twice the length of body; proboscis yellow as are the legs.

Observations were continued up to the first week in July upon these

various forms of the *Chermes* upon the silver fir, and the following summary of conclusions arrived at is given here :—

As already seen, eggs placed in branches at the base of the leaf buds hatch out in May, as the young needles unfold, and the minute larvæ crawl up on to the leaves. After a time these young larvæ apparently develop the white cottony substance and then die and lay fresh eggs on the needles. Later on a generation from these eggs (or a portion of the first generation) collect down towards the base of the needles, and feeding here set up an irritation which results in an exudation of turpentine, and also causes the needles to curl up in a corkscrew manner, the sticky excretions binding them together into a large twisted bud. Within or near the corkscrew bud the following are to be found :—

- (a) Ordinary crimson-coloured larval form.
- (b) Yellow apterous form.
- (c) The yellow-green, silvery winged forms.
- (d) A few dark orange-coloured black-winged forms.

By the end of the first week in July the twisted-up leaves are found to contain numerous eggs covered by the usual dead mother skin and white cottony substance. These are also to be found on the twig and stem of the tree and are very visible. The apterous yellow larvæ will now have mostly left the corkscrew buds, and the numerous white papery skins on the twigs and the untwisted needles in the neighbourhood showed that they moulted after quitting the deformed shoots. This moult, I am of opinion, is the last one gone through, the *Chermes* after shedding this last skin appearing as the light green and yellow silvery-winged insect described above. Although the writer has not absolutely watched the change in colour, he is of opinion that the orange-yellow dark-winged forms are but a later stage of the bright coloured silvery forms, the bright tints assumed after the last change of skin darkening in a similar manner to that of the Spruce gall form described in the previous paper read before this Society. This winged form will probably fly off to the Spruce and lay eggs on it in a similar manner to that of the Spruce gall form which flies to the silver fir on leaving the pseudo-cone and acquiring its wings. I am not prepared as yet, however, to say exactly what happens to these winged forms. I found many dead upon the trees, and this would point to their lives being short in this stage. It is probable that during the heaviest of the monsoon rains the *Chermes* would not be active, and it is possible that this season is passed in the egg stage. I have not yet had an opportunity of observing whether the aphid resumes its activity during the brilliant warm autumn months which succeed the monsoon season in the Himalayan Region.